FOSSIL CERVIFAUNA OF SYATIN NEAR TAINAN, SOUTHWESTERN TAIWAN (FORMOSA)

FOSSIL CERVIFAUNA OF SYATIN NEAR TAINAN, SOUTHWESTERN TAIWAN (FORMOSA)

BY

TOKIO SHIKAMA

With 2 Text-figures and 1 Plate

Syatin is a small village about 20 km east of Tainan, southwestern Taiwan (Formosa) and lies in the Sinka oilfield, occupying the western bank of the Sanzyû-kei, a tributary of the Sobun-kei river. The land around Syatin is a hilly district of about 150 m high and dissected by the river and built of marine Tertiary deposits which are divisible, according to Mr. K. TORII, geologist of the Taiwan Government General into the three beds, Mokusaku, Koteikô and Kityô in ascending order. The Kityô beds of argillaceous sandstone and bluish gray loose sandstone, both very rich in marine Mollusca and Foraminifera, are believed nearly to correspond to the upper part of the Byôritu beds, a Pliocene complex prevailing in northwestern Taiwan. Along the strongly meandered course of the Sanzyû-kei, with its upper part called the Sairyô-kei, is a well developed terrace built of gravels, on which the village of Syatin is situated.

Fossil mammalian remains are often found, most commonly after floods, among the pebbles and boulders of the river-floor of the Sanzyû-kei. As the fossils are all fragmentary and much water-worn, it appears quite evident that their occurrence is secondary.

As a result of a detail survey on the mode of occurrence of the fossil mammals, Prof. I. HAYASAKA of the Taihoku Imperial University, discovered fragments of deer antlers and ox teeth besides several others in the terrace sediments and came to the conclusion that the fossil remains in the terrace gravel are derived from either the underlying Tertiary deposits or from an unknown bed intermediate between the two, and are washed out into the river floor during the flood season, to become mixed among the river boulders and pebbles. He reported a specimen of *Stegodon* from Taikô near Syatin, and suggested that it is from either the Kityô beds exposed nearby or from a more upper horizon of the Tertiary.

The geological age of the deposits with *Stegodon* remains in India, China and Japan is a topic of repeated discussion; for instance, the Wanhsien fissure deposits of China with *Stegodon* closely similar to the species of Taiwan is regarded as Upper Pliocene by MATTHEW and GRANGER and several other workers, and as Lower Pleistocene by TEILHARD DE CHARDIN and YOUNG; I rather tend to the former view and in consequence also to believe the Upper Pliocene age of the Syatin fauna now specially concern.

The noteworthy elements of the Syatin fauna are elephant, deer, wild oxen, wild boar and rhinoceros. In the present paper its Cervifauna only is treated; this comprises,

Cervus (*Sika*) *taevanus*(?) BLYTH

C. (*Sika*) *sintikuensis* (NAGASAWA MS) sp. nov.

C. (*Sika*?) sp. indet.

C. (*Rusa*) *timoriensis*(?) BLAINVILLE

C. (*Depéretia*) *kokubuni* sp. nov.

C. (*Depéretia*?) *syatinensis* sp. nov.

Capreolus(?) *formosanus* sp. nov.

C. (?)sp. indet.

C. sp. indet.

It is noteworthy that no remains of the two important living forms of Taiwan, *Cervus* (*Rusa*) *unicolor swinhoe* SCLATER and *Muntiacus reevesi micrurus* SCLATER are found in the fossil material, and another living species *taevanus* only is represented commonly in it. The subgenus *Depéretia* is represented by 2 species, of which one is doubtful as to the subgeneric position; this is an extinct group, with its species mostly confined to Pliocene deposits of Europe and eastern Asia. Roe deer and one similar to *C.* (*Rusa*) *timoriensis* are forms exotic to the present Taiwan. The deer elements of the Syatin fauna seem to be more favorable to its Upper Pliocene age than to Pleistocene.

While the Syatin fauna is rich in species of deer as cited above, the Wanhsien fauna has but little trace of such kinds; further, the former has no species of deer in common with that of Trinil, Java, or of Nihowan, China.

The specimens are well fossilized, coated with iron-oxide, colored dark brown or with bluish gray tint, and the rock, probably the mother rock attached to the bones consists of gray sand and clay.

The material dealt with were all presented to me by Mr. R. KOKUBUN of the Sinka Agricultural School in 1934, and are now preserved in the collection of the Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai, Japan. At this place I should like to express my cordial thanks to him for so kindly presenting his entire collection to my study. Thanks are also due to Prof. H. YABE and Mr. K. HATAI of the Institute of Geology and Palaeontology, Tôhoku Imperial University, for their help in correction of this article before publication.

Description of the Materials

Genus **Cervus** LINNAEUS, 1766

Subgenus **Sika** SCLATER, 1870

Sika SCLATER, 1870. Proc. Zool. Soc., 1870, p. 115; LYDEKKER, 1915, Cat Ung. Mamm. Brit. Mus., Vol. 4, p. 105.

Subgenotype: *Cervus nippon* TEMMINCK, 1837. Fauna Japonica, Introd., p. 22.

Pseudaxis GRAY, 1872. Cat. Rum. Brit. Mus., p. 70; BROOKE, 1878, Proc. Zool., Soc., p. 907; LYDEKKER, 1898, Deer of all Lands, p. 110; POCOCK, 1910, Proc. Zool., Soc., p. 943.

Subgenotype: *Cervus nippon* TEMMINCK, 1837. op. cit.

Cervus (Sika) taevanus (?) BLYTH, 1860

Pl. XVI (I), Figs. 1-8.

Compared with:—

Cervus taevanus BLYTH, 1860. Jour. Asia. Soc. Bengal, Vol. 29, p. 90; SCLATER, 1860. Proc. Zool. Soc., 1860, p. 376; SCLATER, 1862. ibidem., 1862, p. 152; SWINHOE, 1862. ibidem, 1862, pp. 362-365; BROOKE, 1878. ibidem, 1878, p. 909; LYDEKKER, 1897. ibidem, 1897, pp. 45, 46; TROUSSART, 1898-99. Cat. Mam. Nov. Edit., Tom. 2, p. 880; LYDEKKER, 1898. Deer of all Lands, p. 116.

The Formosan deer, Karoku was distinguished from the Japanese *Sika, C.* (*S.*) *nippon,* principally by the stature of the body and pelage; the antler has not been fully described. The antlers of both are closely related to each other and distinction between them is not clear, although it is said that the distance between the first and second tines is relatively short in the Taiwan deer. Since the criterion just mentioned is insufficient for determination of the fossil antlers and teeth under consideration, comparisons were made with the Japanese deer, *Cervus* (*Sika*) *nippon nippon* TEMMINCK, on the assumption that the antlers and teeth of both species are allied to one another.

Right antler (Reg. No. 59943). Pl. XVI (I), Figs. 1, 2.

Basal part to burr of antler preserved; main beam above bifurcation, apical portion of first tine and pedestal lacking; first tine branching nearly at right angle with beam which is about 50 mm between burr and bifurcation; burr circular in shape, diameter about 30 mm with grooves or granules less distinct than in Japanese deer.

Right antler (Reg. No. 59944). Pl. XVI (I), Figs. 3, 4.

Proximal portion of another antler is at hand; pedestal, both beams and tines above bifurcation lacking; burr nearly circular in shape, about 38 mm in diameter; granules better preserved than above specimen; bifurcation about 50 mm high above burr; basal prong branching, forming with main beam about 60°; grooves more distinct than in modern Japanese *Sika,* and specimen mentioned above.

This antler does not exceed in size that of *Cervus ezoensis* HEUDE, *C. nipppon manchuricus* SWINHOE or *C. hortulorum* SWINHOE, etc., but agrees with that of *C. nippon nippon* TEMMINCK.

Left ramus (Reg. No. 59945). Pl. XVI (I), Figs. 5, 6.

A posterior fragment of the left mandibular ramus of an adult animal bearing the last two molars which are worn and in situ. Teeth bluish-gray and ramus brownish-black in color. Teeth similar to *C.* (*Sika*) *nippon nippon* TEMMINCK in general appearances but are much inferior in size. Accessory column lost; a feeble anterior outer fold preserved in M_2; talon of M_3 injured, nearly quadrate in upper view. Inner surfaces of inner crescents of teeth similar to that of *C. nippon nippon* TEMMINCK, and less angular than that of *C.* (*Sika*) *grayi* ZDANSKY[1] from Shantung. Dimensions of the teeth are as follows:—

	M_2	M_3
Length of crown	15.0	20.5 mm
Maximum width of crown	9.5	9.5 ,,

The crown length of M_2 and M_3 of the specimen is distinctly smaller than that of *C. taevanus* which, according to MATSUMOTO are 18.0 and 24.5 mm respectively. It is also much smaller than that of *C. nippon nippon* TEMMINCK, *C. ezoensis* HEUDE and *C. grayi* ZDANSKY. *Cervus sintikuensis* (NAGASAWA MS)[2], from Tikutô-gai Sintiku-syû, Taiwan, is represented by two mandibular rami of nearly equal size with crowns of teeth strongly compressed and flat-

1) H. MATSUMOTO, 1926. Sci. Rep. Tôhoku Imp. Univ., Ser. 2, Vol. 10, No. 2, p. 27.

2) J. NAGASAWA, 1932. On Fossil Mammals (Graduation Thesis of the Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai, Japan, for 1932, in Japanese Language).

tened. It is comparable with this specimen, but differs in the latter respect. *C. sintikuensis* and the present deer both have the rami about 24 mm at M_3 and are much lower than *C. nippon nippon* TEMMINCK or *C. grayi* ZDANSKY with corresponding height of about 35.0 and 38.0 mm respectively.

The ramus of *sintikuensis* and the present one is about 12 mm thick immediately below M_3, the maximum thickness of the lower jaws in *C. nippon nippon* and *C. grayi* is about 15.0 to 20.0 mm, while that of *C. pachyosteus* YOUNG exceeds 40.0 mm in average. As may be seen, the thickness of the lower jaws of the present specimen is small. In the structure of the teeth, basal elements of the crowns or dimensions of the ramus, etc., this specimen stands next to *C. taevanus* or to *C. nippon nippon*. Even though it can not be ascertained that this ramus is identical with that of *C. taevanus*, I would prefer to provisionally refer them to that species.

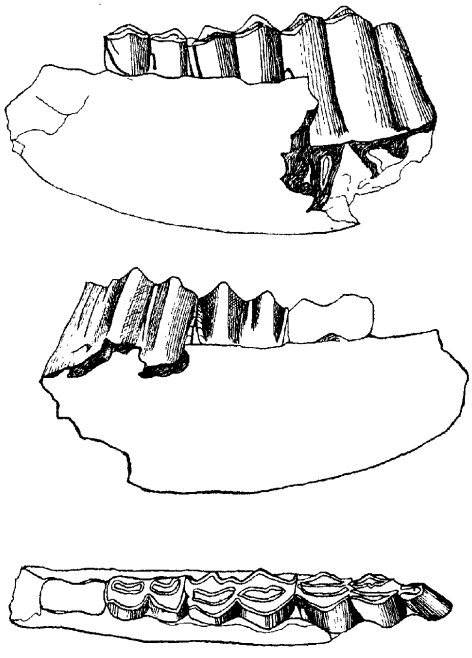
Since *C. taevanus* is not known to occur as fossil in Taiwan or other countries, these specimens are, I believe, valuable in furnishing more knowledge on the history and antiquity of this species.

Detached right lower M_2 (Reg. No. 59946). Pl. XVI (I), Figs. 7, 8.

A detached right second molar, referable to *C. taevanus*; similar to that of *C. nippon nippon* TEMMINCK in general shape and dimensions. The posterior outer fold and accessory column between both inner crescents are moderately developed and both outer and inner crescents distinctly project outwardly and inwardly as in *C. nippon nippon* TEMMINCK; length of crown about 16.0 mm and width of first lobe about 10.0 mm.

Cervus (Sika) sintikuensis (NAGASAWA MS) sp. nov.[1]

Pl. XVI (I), Figs. 9-11



Text-fig. 1.

Cervus (Sika) sintikuensis (NAGASAWA MS.) sp. nov. Left ramus of the holotype after Mr. J. NAGASAWA.

Homoeotype: A right lower third molar (Reg. No. 59947).

Holotype: Temporary in the Institute of Geology and Palaeontology, Tôhoku Imperial University.

According to Mr. J. NAGASAWA (MS), this species is nearest to *C. nippon nippon* TEMMINCK, but may be distinguished from it in narrow characters of M_3. The holotype is represented by both right and left rami; the former carries P_3 to M_3, the dimensions according to NAGASAWA are as follows;

	P_3	P_4	M_1	M_2	M_3
Length of crown	—	9.4	12.4	14.5	20.5mm
Width of crown near base	5.0	5.4	8.0	8.4	8.0 ,,

The cotype of his specimens has no distinct accessory column but preserves the rudimentary tubercle between the second and third lobes.

My material, which is referred to this species, is a right lower third molar about 23 mm

1) J. NAGASAWA, 1932. op. cit.

long and about 9 mm wide at first lobe. It carries a moderate anterior fold and a rudimentary tubercle between first and second inner crescent. The basal cingulum is not developed and upward tapering of lobes not acute; talon hemicircular in upper view. In the outer and inner crescents being very compressed and flattened it is allied to *C. sintikuensis*. Since most deers do not have flattened molars as *sintikuensis* there is no doubt of its being a valid species though much allied to *C. nippon nippon* TEMMINCK or *C. taevanus* BLYTH.

Diagnosis of *C. sintikuensis* (NAGASAWA MS) sp. nov.;

Rather small deer allied to *C. nippon nippon* or *C. taevanus*; teeth distinctly compressed and flattened, third lower molar not exceeding 10 mm in width; accessory columns not well developed.

Type locality: Tikutô, Sintiku-syû, Taiwan.

Cervus (Sika ?) sp. indet.

Pl. XVI (I), Figs. 12–14.

Lower left ramus (Reg. No. 59948).

A fragment of posterior portion of left ramus bearing three, much worn teeth in situ, probably of an aged animal; lower half of ramus and anterior inner portion of first molar missing. Teeth rather small, somewhat like those of the left ramus of *C. taevanus*(?), above mentioned; it carries feeble accessory tubercles between fore and aft inner crescents of M_1 and M_2, and also M_3, but no distinct anterior or posterior folds. Inner crescents compressed, flattened; aft crescent of M_2 and M_3 comparatively rather angular; inner surface of folds round compressed, without clear distinction between median and lateral folds; no distinct basal cingula or palaeomeryx fold known.

Characteristics of this specimens, are the teeth which are strongly and closely set with one another, hence their total length is very small; especially the first two molars are very short in length. Dimensions of the teeth are;

	M_1	M_2	M_3
Length of crown	12.0	14.5	19.5 mm
Maximum width of crown	9.0	9.0	9.0 ,,

As shown by NAGASAWA and MATSUMOTO[1], the length of teeth of *C. nippon nippon* TEMMINCK or of *C. taevanus* is never less than 22.0 mm in M_3 and 15.0 in M_2, while in the other species of *Sika*, it is much greater. In the living *C. nippon nippon* TEMMINCK, according to NAGASAWA's measurements, M_1 is about 15.7–15.3 (living) or 15.2–14.0 (neolithic); M_2 about 17.6–16.8 (living) or 18.3–17.9 (neolithic); and M_3 about 24.9–23.5 (living) or 25.0–24.4 (neolithic) mm in average length. He also states that the dimensions are smaller in the fossil than in the living form of *C. nippon nippon* TEMMINCK. The specimen now under consideration is even smaller than the fossil mentioned by J. NAGASAWA in dimensions. The average length of M_1, M_2 and M_3 of *C. taevanus* BLYTH are 15.5, 18.0 and 24.5 mm respectively, according to MATSUMOTO. It may easily be seen that the specimen at hand is clearly smaller than the majority of the teeth of *Sika*. Compared to the teeth of Muntjac, especially *Muntacus reevesi micrurus* SCLATER, a species now living in Formosa, the dimensions of my specimen are larger. Detailed

1) J. NAGASAWA, 1932: Jour. Geol. Soc. Tokyo, Vol. 39, p. 72.
H. MATSUMOTO, 1926: op. cit., p. 29.

descriptions of the antlers and pelages of the genus *Muntiacus* (*Cervulus*) are known, but for its teeth, we owe our knowledge to RÜTMEYER[1] who, in regard to the Muntjac teeth states;

"Da auf so schwierigem Gebiet jeder noch so kleine Anhaltspunkt erwünscht sein muss, so verdient endlich noch bemerkt zu werden, dass ein nicht wenig in die Augen fallendes Merkmal bei *Cervulus* darin besteht, dass der Email-Ueberzug für Zähne von so geringer Grösse besonders stark, und durch Schwinden der für Hirschzähne sonst so üblichen Runzelung ungewöhnlich glatt erscheint. Da überdiess alle zahnwände in jeder Richtung eigentümlich gewölbt und gerundet sind, so dass namentlich die sehr massiven Mittelrippen (oben namentlich an Vorderhälften von Molaren und also auch an Praemolaren, unten an beiden Hälften der Innerwande....bis zu gänzlichen Auslöchen von Seitenfalten) und auch die Querjöche oder Halbmonde nicht Kantig, sondern sehr gerundet vortreten, so gibt dies alles dem Muntjakgebiss ein Gepräge von Abrundung und Politur eigenthümlicher Art, welche es im Vergleich zu andern Hirschzähnen fast wie aus Porzellan gebildet erscheinen lässt".

As the porcelain-like smooth surface of enamel is not seen in the present specimen, Muntjac may be excluded from consideration. From consideration, the following forms may be excluded of the little forms of deer in Asia, namely, *Moschus, Hydropotes* or *Elaphodus*. At the present time it appears more advisable to refer this specimen to the subgenus *Sika*.

Since the Pliocene of China, Japan or the neighboring area yield no decisive fossil of *Sika* the original or ancestral forms of the Sikine deers in Eastern Asia are unknown. YOUNG[2] holds the view that *C. grayi* ZDANSKY and *C. magnus* ZDANSKY are from the Choukoutien age (Lower Pleistocene) and not from the Nihowan age (Upper Pliocene). Therefore the small form of my deer might be ancestral to the subgenus *Sika* in Asia.

Subgenus **Rusa**, H. SMITH, 1827

Rusa, H. SMITH, 1927. GRIFFITH's Animal Kingdon, Vol. 4, p. 108 (type in Paris Museum); BROOKE, 1878. Proc. Zool. Soc., 1878. p. 900; RÜTIMEYER, 1881. Abh. Schweiz. Pal. Ges., Vol. 3, p. 23; LYDEKKER, 1898. Deer of all Lands, p. 141; POCOCK, 1910. Proc. Zool. Soc. 1910, p. 946; LYDEKKER, 1915. Cat. Ung. Mamm. Brit. Mus., Vol. 4, p. 60.

Subgenotype: *Cervus unicolar* BECHSTEIN, 1799. Uebersicht vierfüss, Thiere Vol. 1, p. 112.

Hippelaphus SUNDEVALL, 1846. K. Svenska Vet.-Ak. Handl., 1844, p. 176.

Subgenotype: *Cervus unicolar equinus* CUVIER, 1823. Ossemens Fossiles ed. 2, Vol. 4, p. 45.

Ussa HEUDE, 1888. Mém. Hist. Nat. Emp. Chinois, Vol. 2, p. 20.

Genotype: *Ussa gorrichanus* HEUDE, 1888. op. cit., p. 21.

Sambar HEUDE, 1888. op. cit., pp. 20, 41.

Genotype: *Sambar curvicornis* HEUDE, 1888. op. cit., p. 42.

Cervus (Rusa) timoriensis (?) BLAINVILLE, 1822

Pl. XVI (I), Fig. 15.

Compared with:—

Cervus timoriensis BLAINVILLE, 1822. Jour. Phys., 1822, p. 267; BROOKE, 1878. Proc. Zool. Soc., 1878, p. 903; LYDEKKER, 1915. Cat. Ung. Mamm. Brit. Mus., Vol. 4, p. 63.

Cervus peronii CUVIER, 1825. Ossemens Fossiles, ed. 3, Vol. 4, p. 46.

Cervus hippelaphus CUVIER, 1823. op. cit., ed. 2, Vol. 4, p. 40.

LYDEKKER[3] separates *Cervus timoriensis* BLAINVILLE, into three subspecies, namely, *C. timoriensis timoriensis* BLAINVILLE, 1822 (Timor), *C. t. moluccensis* QUOY and GAIMARD, 1830

1) RÜTIMEYER, 1883: Abh. Schweiz. Paläont. Geselschäft, Vol. 10, p. 28.
2) C. C. YOUNG, 1932: Pal. Sinica, Ser. C, Vol. 8, Fasc. 2, p. 66.
3) LYDEKKER, 1915: Cat. Ung. Mamm. Brit. Mus., Vol. 4, p. 64.

(Molluca group), and *C. t. hippelaphus* CUVIER, 1823 (Java). The lack of a sufficient number of specimens does not permit me to make a comparison among these subspecies.

Left antler (Reg. No. 59949).

Proximal portion of a rather small, slender and considerably water-worn left antler with pedicle, probably belonging to a young; first tine and main beam above bifurcation lacking. Pedicle round in shape, about 54 mm high along outer side; bifurcation about 32 mm high above burr; burr not rugose, water-worn, about 30 and 27 mm in diameters; beam round, extending rather oblique to pedicle; first tine apparently branched at about 60° to main beam. Surface less rugose than *C.* (*Rusa*) *unicolar* BECHSTEIN or *C.* (*R.*) *timoriensis hippelaphus* CUVIER and smooth like *C.* (*R.*) *timoriensis moluccensis* QUOY and GAIMARD.

Undoubtedly this antler belongs to the Rusine deer. The Sambar, *C.* (*Rusa*) *unicolor* BESCHSTEIN[1], which is often placed in the synonymy of *C. aristotelis* CUVIER contains more than thirteen subspecies in the Oriental region. Its antlers are much larger, stouter and more rugose than the present one. *C.* (*Rusa*) *kuhli* MÜLLER and SCHLEGEL[2] from the Bawean Islands, *C.* (*Rusa*) *pachygnathus* ZDANSKY[3] from the reddish clay of Shansi, China, or *C.* (*Rusa*) *elegans* TEILHARD and PIVETEAU[4] from the Nihowan bed of Chili, China are distinguishable from the present specimen in the same respects. The Taiwan Sambar, *C.* (*Rusa*) *unicolar swinhoei* SCLATER[5], now living in Taiwan, is also distinguished from the present specimen by the above mentioned points. *C.* (*Rusa*) *oppenorthi* KOENIGSWALD[6] occurring in Semboengan, Java is somewhat related to this antler in the slender forms but differs in the branching of the first tine being higher above the burr; *C.* (*Rusa*) *stehlini* KOENIGSWALD[6] from the Lower Boemiajoe bed of Boemiajoe, Java is also allied to my specimen, but is distinct in the angle between the main beam and the first tine being more acute. Both Javan fossil *Rusa* described and figured by KOENIGSWALD are larger than this antler in dimensions. Since the antlers of both *C.* (*Rusa*) *orientalis* KOKEN and *C.* (*Rusa*) *leptodus* KOKEN[7] from the Pliocene of China are not known, a comparison cannot be made. *C. namadicus* MEDLICOTT and BLANFORD[8] from the Pleistocene of India is omitted from consideration as it is a synonym of a hyponymoid form, placed in the subgenus *Rusa* by TROUESSART[9]. *C.* (*Rusa*) *timoriensis* BLAINVILLE more popularly known as *C. hippelaphus* CUVIER is closely related to this specimen, except for the antler which is closer to *C. t. moluccensis* than to *C. t. hippelaphus*. The former is distinguished from the present specimen by the longer pedicle, lower bifurcation and more obtuse angle made by beam and first tine, etc. The Javan *Rusa, C. t. hippelaphus* seems to have larger, stouter and more rugose antlers than the present one which may perhaps belong to a young. According to LYDEKKER, *C. t. timoriensis* BLAINVILLE is distinguished from the Moluccan *Rusa* principally by the different stature of body and pelage and by wider antlers; its size, however, is nearly the same. In the angle of antlers

1) BECHSTEIN, 1799: op. cit.
2) MÜLLER and SCHLEGEL, 1844: Verh. Nat. Ges. Ned., Zool., p. 223 (type in Lyden Museum).
3) ZDANSKY, 1925: Pal. Sinica, Ser. C, Vol. 2, Fasc. 3, p. 72 (type in Upsala Museum).
4) TEILHARD and PIVETEAU, 1930: Ann. Pal., T. 19, p. 54 (type in Paris Museum).
5) SCLATER, 1862: Proc. Zool. Soc., 1862, p. 152 (type in British Museum).
6) KOENIGSWALD, 1933: Wetens. Meded., No. 23, pp. 76, 78 (type in Buitenzorg Museum).
7) KOKEN, 1885: Pal. Abh., pp. 57–61 (type collected by RICHTHOFEN, in Pal. Abth. Kgl. Min. Museum, Berlin).
8) MEDLICOTT and BLANFORD, 1878: Geol. India, pp. 385, 574.
9) TROUESSART, 1889: op. cit., p. 874.

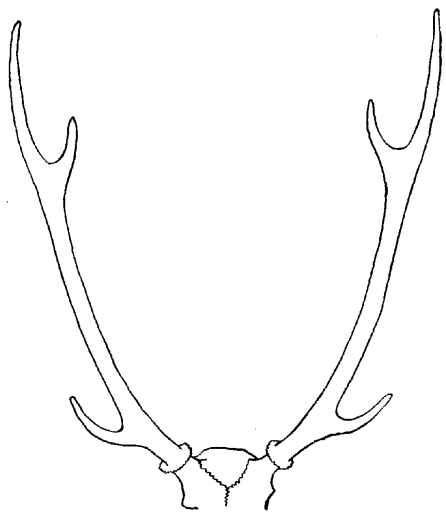
my specimen seems to be distinct from the Timor *Rusa*. However, in the present state of preservation, the specimen in question may be best referred to *C.* (*Rusa*) *timoriensis*.

C. timoriensis hippelaphus CUVIER has been recorded as fossil from Ngandon, Watoelang, and other localities in Java (Pleistocene?), according to KOENIGSWALD[1].

Subgenus **Depéretia** SHIKAMA, 1936

Depéretia SHIKAMA, 1936. Proc. Imp. Acad., Vol. 12, No. 8, p. 251.
Subgenotype: *Cervus* (*Depéretia*) *praenipponicus* SHIKAMA, 1936. Jour. Geol. Soc. Jap., Vol. 43, No. 510. (type in Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai, Japan).

This subgenus is closely related to the Arde deer (*Anoglochis*) and is quite distinct from the subgenera, *Sika, Rusa* or *Axis,* in the position and length of the first tine, branching of the inner tine of terminal fork. The antler of this subgenus is distinguishable from that of the Sambar group by the shorter and smaller first tine and by inward branching of the second tine very high above the first tine or by the higher position of the first tine above the burr. In the general position and direction of branching of the tines, it resembles the Chital (subgenus *Axis*) but differs by the more acute angle between the beam and the first tine, smaller form and higher position on the beam of the first. The beam of the subgenus is less stout and smaller than that of *Rusa* or *Axis*. *Sika* is distinct from *Depéretia* in the lower position of the second tine and first tine above beam. On the other hand, there seems as if the second tine of *C.* (*Sika*) *ezoensis* HEUDE has disappeared in this subgenus. Probably, *Sika, Rusa* and *Depéretia* sprung from a common ancestor in the Pliocene or Miocene (for example, *Cervocerus Novorossiae* KHOMENKO from the *Hipparion* bed of Shansi and South Russia or *Cervus speciosus* SCHLOSSER from the same bed of Ertemte, Inner Mongolia) simultaneously, and also derivatives of the same stock are the European Upper Pliocene forms, *Sika, Eucladoceros, Depéretia,* and *Anoglochis* (*Elaphurus* of TEILHARD and PIVETEAU). The subgenus *Anoglochis* based on *C. ardeus* CROIZET and JOBERT differs from *Depéretia* in the mode of terminal forking of the beam.



Text-fig. 2.

Cervus (*Depéretia*) *praenipponicus* SHIKAMA
Restored figure of the adult male antlers.

This subgenus now contains the five species, *praenipponicus, borbonicus, naorai, kokubuni,* and *syatinensis. Cervus kazusensis* MATSUMOTO from Umegase (Pliocene) may perhaps belong to this group. Both *kokubuni* and *syatinensis* described below lack their upper portion of the antlers, therefore there remains a probability of their belonging to *Anoglochis* instead of to *Depéretia.* However, in there being no clear evidence of the former existence of the subgenus in Eastern Asia, both species are refered to *Depéretia.*

1) KOENIGSWALD, 1933: op. cit., p. 85.

Cervus (*Depéretia* ?) *kokubuni* sp. nov.

Pl. XVI (I), Figs. 16–18.

Holotype: A proximal portion of a right antler (Reg. No. 59950).

First tine and main beam broken off above bifurcation; pedicle lost. Antler rather flat, round at burr which is about 33 mm in diameter. First tine branching about 73 mm above burr, very flat in shape; webb as preserved about 90 mm above burr. Antler characterized by beam which distinctly bends outwards as in *C. kazusensis* MATSUMOTO, a species which is closely allied but distinguished from the present one by higher position of first tine upon beam which is smooth above burr. Antler not rugose, rather distinctly grooved on surface.

This species is distinguishable from the majority of the species of *Depéretia* by the extraordinary bending of the antler outwards. At present *kazusensis* is the oldest record (Lower Pliocene) of *Depéretia* or *Anoglochis*-like deer in Eastern Asia, therefore, *kokubuni* may indicate the antiquity of the cervifauna of Syatin-syô.

Cervus (*Depéretia* ?) *syatinensis* sp. nov.

Pl. XVI (I), Figs. 19, 20.

Holotype: A proximal portion of a young left antler (Reg. No. 59951).

Small slender antler of a young exhibiting characters different from the species above mentioned. Portion below bifurcation preserved, pedicle lacking. Burr apparently was rather rugose and round, diameter (restored) about 27 mm. Beam below and just above webb characteristically round and smooth. First tine branching at about 70° at considerable distance above burr, main beam rather keeled backwards as in *C. kazusensis* MATSUMOTO. General shape and appearances similar to *kazusensis* and the young of *kokubuni*.

Genus **Capreolus** GRAY, 1821

Capreolus GRAY, 1821. Med. Repos., Vol. 15, p. 307; BROOKE, 1878. Proc. Zool. Soc., 1878, p. 917; RÜTIMEYER, 1881. Abh. Schweiz. Pal. Ges., Vol. 8, p. 41; LYDEKKER, 1898. Deer of All Lands, p. 222; POCOCK, 1910. Proc. Zool. Soc., 1910, p. 957; MILLER, 1912. Cat. Mamm. West Europe, p. 972; LYDEKKER, 1915. Cat. Ung. Mamm. Brit. Mus., Vol. 4, p. 218.

Genotype: *Capreolus capreolus* LINNAEUS, 1758. Syst. Nat. ed. 10, Vol. 1, p. 68.

The genus *Capreolus* includes many fossil forms such as *C. curotceros* KAUP and *C. haplodon* MEYER (Miocene of Germany), *C. matheronis* GERV. (Upper Miocene to Lower Pliocene of France and Hungary), *C. pentelici* GAUDRY (Pontian of Pikermi, Greece), *C. australis* SERRES (Pliocene of Europe), *C. cusanus* CROIZET and JOBERT, *C. neschrensis* DEPÉRET, *C. buladensis* DEPÉRET, *C. ruscinensis* DEPÉRET, and *C. leptocerus* POMEL (Pliocene of France), *C. orobius* BALS., and *C. affinis* CORNALIA (Pleistocene of Italy), *C. capreolus* LINN. (Pleistocene of Europe) or *C. manchuricus* LYDEKKER (Pleistocene of Manchuria), etc. Living forms are represented by *C. capreolus* LINN. (European roe), *C. pygargys* PALLAS (Siberian roe) and *C. manchuricus* LYDEKKER (*C. bedfordi* THOMAS, Manchurian roe), all are restricted in the Holoarctic region, and not known south of the Himalayan mountains. In eastern Asia the southern limit for the fossils lie in Shansi, Kansu and Formosa, regions quite remote from their living area.

Details and discussions of this genus are already given by the authors mentioned. In China, the oldest record of *Capreolus* is the *Hipparion* red clay. A closely related genus *Procapreolus* SCHLOSSER, 1924[1] from Inner Mongolia has two species, *P. rütimeyeri* (SCHLOSSER), 1903[2] from Inner Mongolia and *P. latifrons* SCHLOSSER, 1924[3] from Paotehsien, Shansi and Inner Mongolia. Characters of their antlers are completely described by SCHLOSSER (1924) and by ZDANSKY (1925); for *P. rütimeyeri* (SCHLOSSER) the genotype of *Procapreolus*, SCHLOSSER gives the following diagnosis;

"Antlers of moderate size, not much diverging, inclined somewhat backwards, stock rather high, compressed from back to front, burr weakly developed, beam nearly triangular in section, between the highly inserted first tine and the burr a prominent crest. First tine weak, not much diverging and directed upward and forward. Beam nearly straight, passing into the forward and inward pointing second tine. Second bifurcation nearly three times more distant from the burr than the first. Third tine not much weaker than the second and obliquely directed backward and upward. Surface of beam covered with broad longitudinal furrows between sharp crests, but no pearls."

The cotype of this species consists of detached molars. The antler later assigned to this species with the diagnosis just mentioned, by SCHLOSSER is most allied to *C. cusanus* CROIZET and JOBERT, or *C. capreolus* LINN. though distinguished from them by the conspicuous triangular section of beam even between the first and second bifurcations. Concerning the antlers only, the genus *Procapreolus* appears to be almost congeneric with *Capreolus* providing there no doubt that *C. cusanus* CROIZET and JOBERT or *C. matheronis* GERVAIS belong to *Capreolus*. According to SCHLOSSER, the generic characteristics of *Procapreolus* are its teeth, namely the simple structure of the premolars, presence of spurs in upper molars or presence of *Palaeomyryx*-fold, showing more archetypeal characters than the roe. Hence, the author referred *Procapreolus* to be the inheritor of *Palaeomerycinae*. It is very interesting and significant that the descendant of the genus *Procapreolus*, is not known to occur as fossil in China or her adjacent areas. From the upper Pliocene bed of Nihowan no *Capreolus*-like deer is known to occur and from the fissure deposits of Loc. 1 of Choukoutian is only known a lower jaw of deer referred to *Capreolus* sp. by YOUNG[4]. While in the middle Pleistocene bed of Harbin, Manchuria (the Sungari sand), the Manchurian roe, *Capreolus manchuricus* LYDEKKER is common. Accordingly we have but scanty knowledge of the roe during the late Pliocene to the Middle Pleistocene in eastern Asia. Therefore the specimen described below is rather interesting and important.

Capreolus (?) *formosanus* sp. nov.

Pl. XVI (I), Figs. 21, 22.

Holotype: A proximal portion of left(?) antler. (Reg. No. 59952).

A straight and rather flat antler perhaps of a young; it is small, pedicle and main parts of beam lost. Burr apparently was rugose, like that of the roe, about 30 mm in restored dimension. Beam little keeled backwards, not circular, nearly quadrate in section; becoming much

1) SCHLOSSER, 1924: Pal. Sinica, Ser. C, Vol. 1, Fasc. 1, p. 75.

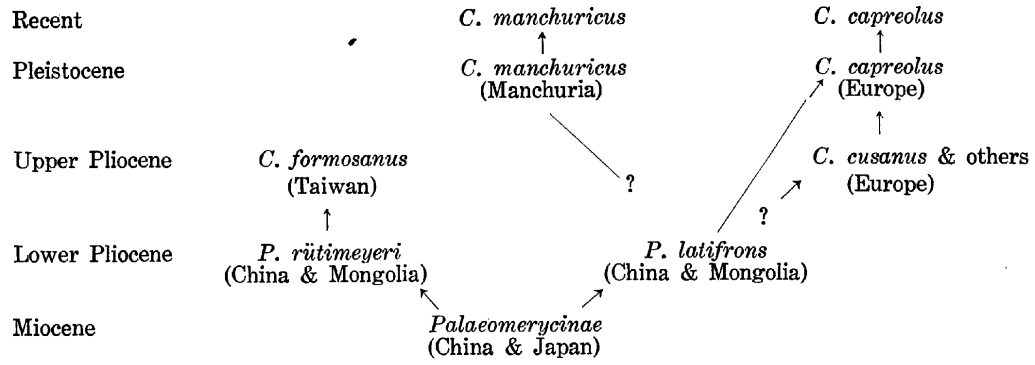
2) SCHLOSSER, 1903: Abh. Bayr. Akad. Wiss., II Cl. Vol. 22, Abth. 1, p. 19, pl. 10, figs. 1–5, 8. (type collected by HABERER, probably in München Museum); SCHLOSSER, 1924: op. cit., p. 27, pl. 4, figs. 24, 25, 29, 31–34, pl. 5, fig. 11; ZDANSKY, 1925: Pal. Sinica, Ser. C, Vol. 2, Fasc. 3, p. 7.

3) SCHLOSSER, 1924: loc. cit., p. 87, pl. 4, fig. 30, pl. 5, fig. 12. (type collected by ANDERSON, probably in Upsala Museum); ZDANSKY, 1925: op. cit., p. 24, pl. 5, fig. 5, pl. 6, figs. 1–3.

4) YOUNG, 1932: op. cit., p. 24, pl. 6, fig. 13.

flattened upwards, a feeble rough portion appears on beam about 45 mm above burr. Surface of beam with strong longitudinal furrows but no tubercles.

This antler is most related to *Procapreolus rütimeyeri* SCHLOSSER in the *Capreolus* group, in dimensions and surface of beam; however, it is distinguished from it in the section of beam. *Capreolus capreolus* LINN. also differs in the section of beam; the Siberian or Manchurian roes differ in the surface of beam; such characteristic rugose and sharp tubercles as seen in them are not found in this specimen. It is distinguishable from most forms of the European Upper Pliocene roe, in the surface and sections of beams. At present I am unaware of related forms to the present one, except for the Chinese *Procapreolus*. Nevertheless I am rather inclined to interpret *formosanus* as a descendant of *P. rütimeyeri* (SCHLOSSER) in the Far East. Morphogenetically, the following may be schematized;



Capreolus (?) sp. indet.

Pl. XVI (I), Figs. 23, 24.

A fragment of an antler (Reg. No. 59953).

A fragment of the beam of a peculiar shape; it is large in size with very rugose surface, and a prominent tubercle and conspicuous grooves. Probably this antler is related to the roe, for the Siberian or Manchurian roes sometimes carry eminent tubercles on the beams of adult; similar tubercles are also seen in deer antlers from the Inland Sea, known as *Capreolus* (*Capreolina*) *mayai* TOKUNAGA and TAKAI[1].

Cervus sp. indet.

Pl. XVI (I), Figs. 25–28.

Besides the above mentioned specimens, there are several other undetermined fragments of antler, detached teeth and limb bones of deer. Of them two antler fragments are rather rugose on surface with conspicuous grooves or tubercles; their sections are nearly circular in shape. A small detached molar of slender form, probably of the upper left side is not much worn (Figs. 25, 26). With basal part of the crown damaged; accessory tubercle is not known but a feeble anterior fold is present; projection of the crescent is rather acute. A right astragulus has the dimensions and shape similar to *C.* (*Sika*) *nippon nippon* TEMMINCK or *C.* (*Depéretia*) *praenipponicus* SHIKAMA, but owing to its undecisive characters and insufficient number of specimens for comparison, its taxonomical position is for a while left in question (Figs. 27, 28).

1) TOKUNAGA and TAKAI, 1936: Trans. Pal. Soc. Jap., No. 19, pp. 642–645, 2 figs., 1 pl.

PLATE XVI (I)

All figures in natural size.

Figs. 1, 2. *Cervus* (*Sika*) *taevanus*(?) BLYTH, proximal portion of right antler, Reg. No. 59943. Fig. 1, outer side; fig. 2, inner side ..... p. 77 (3)

Figs. 3, 4. *Cervus* (*Sika*) *taevanus*(?) BLYTH, proximal portion of right antler, Reg. No. 59944. Fig. 3, inner side; fig. 4, outer side ..... p. 77 (3)

Figs. 5, 6. *Cervus* (*Sika*) *taevanus*(?) BLYTH, fragment of left ramus, Reg. No. 59945. Fig. 5, inner side; fig. 6, outer side ..... p. 77 (3)

Figs. 7, 8. *Cervus* (*Sika*) *taevanus*(?) BLYTH, detached right lower M_2, Reg. No. 59946. Fig. 7, inner side; fig. 8, outer side ..... p. 78 (4)

Figs. 9, 10, 11. *Cervus* (*Sika*) *sintikuensis* (NAGASAWA MS.), sp. nov., a right lower M_3, Reg. No. 59947. Fig. 9, inner side; fig. 10, upper side; fig. 11, outer side ..... p. 78 (4)

Figs. 12, 13, 14. *Cervus* (*Sika*?) sp., a fragment of lower left ramus, Reg. No. 59948. Fig. 12, outer side; fig. 13, upper side; fig. 14, inner side ..... p. 79 (5)

Fig. 15. *Cervus* (*Rusa*) *timoriensis*(?) BLAINVILLE, proximal portion of left antler, Reg. No. 59949, outer side ..... p. 80 (6)

Figs. 16, 17, 18. *Cervus* (*Depéretia*) *kokubuni* sp. nov., holotype, proximal portion of right antler, Reg. No. 59950. Fig. 16, outer side; fig. 17, anterior side; fig. 18, inner side ..... p. 83 (9)

Figs. 19, 20. *Cervus* (*Depéretia*) *syatinensis*, sp. nov., holotype, proximal portion of young left antler, Reg. No. 59951. Fig. 19, outer side; fig. 20, inner side . p. 83 (9)

Figs. 21, 22. *Capreolus*(?) *formosanus* sp. nov., holotype, proximal portion of probably left antler, Reg. No. 59952. Fig. 21, inner side; fig. 22, outer side ... p. 84 (10)

Figs. 23, 24. *Capreolus*(?) sp., fragment of antler, Reg. No. 59953 ..... p. 85 (11)

Figs. 25, 26. *Cervus* sp., detached upper left molar, Reg. No. 59980. Fig. 25, outer side; fig. 26, inner side ..... p. 85 (11)

Figs. 27, 28. *Cervus* sp., right astragalus, Reg. No. 59956 ..... p. 85 (11)

K. Kimura photo.